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Effects of Reid Vapor Pressure on Hydrocarbon Evaporative Emissions

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16. ABSTRACT

This report discusses the results of a test program conducted at EPA's Motor Vehicle Emission Laboratory to investigate the effect of gasoline volatility, as measured by Reid Vapor Pressure (RVP), on evaporative hydrocarbon (HC) emissions. The program consisted of a series of short test sequences designed to quantify these effects. The principal test variables were the vehicle evaporative standard, test fuel, test driving cycles, and prep cycles.

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Abstract

A test program was conducted to investigate the effect of gasoline volatility, as measured by Reid Vapor Pressure (RVP), on evaporative hydrocarbon (HC) emissions. The program consisted of a series of short test sequences designed to quantify these effects. The principal test variables were the vehicle evaporative standard, test fuel, test driving cycles, and prep cycles.

Testing of eight typical passenger vehicles was conducted at EPA's Motor Vehicle Emission Laboratory from October 1983 through January 1984. Three were manufactured to a 6.0 gm standard (1978-80 model year) while the other five met a 2.0 gm standard (1981 model or later). Two of the latter were fuel injected to increase the technology mix. The vehicles were tested using Indolene (RVP of 9.0 psi), commercial unleaded (RVP of 11.7 psi), and a blend of these two fuels (RVP of 10.4 psi). The basic test procedure was the Federal Test Procedure (FTP) which uses the LA-4 driving cycle. Evaporative emissions were measured using the SHED enclosure prescribed by this procedure. A modification of this procedure using 10 minute segments of the LA-4 cycle was utilized to investigate the effects of different driving cycles. Vehicles were prepped for the test by the LA-4 (per the FTP), the above LA-4 segments, or a 10 minute road route.

The overall conclusion from these tests is that the increase in fuel RVP significantly increased evaporative emissions and that most of this effect occurred in the diurnal evaporative emissions. For all vehicles, diurnal emissions with commercial fuel averaged three times the level with Indolene. Hot soak emissions with commercial fuel were 30% above the Indolene levels for the 2.0 gm vehicles and were three times the Indolene levels for the 6.0 gm vehicles.

The use of a 10 minute road prep or 10 minute segments of the LA-4 instead of the standard prep (the 23 minute LA-4) tended to cause an additional increase in diurnal evaporative emissions. However, although individual vehicles did show marked increases or decreases, no consistent pattern was evident.

Exhaust emissions (HC, CO and NO_x) and fuel economy were not significantly changed by these changes in the fuel.

1.0 Background

Ambient air quality models are used to estimate and predict the levels of atmospheric emissions. The mobile source components of these models utilize mobile source emission models (i.e., MOBILE2, MOBILE3)* to predict the emissions of the total population of vehicles. The input data for these mobile models come from in-use vehicle testing programs.

Over the past several years, the volatility of commercial fuels, as measured by Reid Vapor Pressure (RVP), has been increasing. Higher values of RVP are known to cause increases in the levels of evaporative emissions. Also, the in-use test programs** have indicated that evaporative emissions with commercial fuels are significantly higher than with Indolene.*** Since the calculations and projections of ambient air quality have been based on the results obtained using Indolene as the test fuel, it was postulated that the amount of evaporative emissions was being underestimated.

This test program was undertaken in order to immediately acquire some additional data for MOBILE3, to quantify the effects of RVP on evaporative emissions, and to gain some testing experience with the problems likely to be encountered in the current in-use test program. These problems include road versus dynamometer preconditioning, need for preconditioning between different test fuels, length and time of travel (purging) before the diurnal and hot soak evaporative tests, and the repeatability of the tests.

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* MOBILE2 is the model presently used to estimate the fleet emissions. MOBILE3 is an updated version that is now being developed.

** "A Study of Emissions From Passenger Cars in Six Cities" (FY77). EPA-460/3-78-011, January 1979.

*** Indolene is a reference gasoline used by EPA as the test fuel for emission and fuel economy tests because its consistency is better controlled than commercial fuel. Evaporative emissions are measured during these tests.

2.0 Test Plan

The vehicles were tested for evaporative and exhaust emissions using the basic cold-start FTP with SHED test for evaporative emissions. The standard evaporative test sequence is outlined in Appendix A-1 and is summarized below:

refuel vehicle
LA-4 dynamometer prep
overnight soak
refuel with chilled fuel
diurnal evap test
FTP
hot soak evap test

Note: For each test sequence in which there was a change in the type of fuel used, the vehicle was preconditioned with a 125 mile road route before the replicate testing.

The vehicles were tested with Indolene, commercial unleaded, and a blend of these two so as to cover a range of RVP. Two back-to-back sequences were performed at each step in the process. The test program was subsequently modified to add the following testing: (1) replace the standard LA-4 prep with the 10 minute road test of an EPA in-use vehicle test program, (2) test with the blended fuel only those vehicles that show a large increase in evaporative emissions with commercial fuel, (3) test the five 2.0 gm vehicles with commercial fuel using two 10 minute cycles to be derived from the LA-4 cycle, and (4) test one vehicle for test fuel carry over effects. The test sequences followed are detailed in Appendix A and are summarized below:

RVP Effects on Vehicle	Standard evaporative emission test on all eight vehicles with both Indolene and commercial unleaded.
RVP Effects on a Vehicle using 10 minute Road Prep	Standard evaporative emission test on five vehicles with commercial unleaded using a 10 minute road prep instead of the LA-4 dynamometer prep.
RVP Effects of Indolene/ Commercial Blend	Standard evaporative emission test on three vehicles with the blended fuel.
RVP Effects on Vehicle using Modified Driving cycles.	Evaporative emission test on five vehicles with commercial unleaded using the two 10 minute driving cycles instead of the LA-4 driving cycle.

Carry over RVP Evaporative Emission Effects	Standard evaporative emission test on one vehicle using Indolene, then commercial unleaded, then Indolene.

3.0 Test Vehicles

Five typical 2.0 gm standard (1981 model or later) vehicles were selected. Two of these were fuel injected.

1981 Ford Escort, 1.6 liter, 4-cylinder
1983 Plymouth Reliant, 2.2 liter, 4-cylinder
1982 Chevrolet Citation, 2.5 liter, 4-cylinder fuel injected
1983 Ford LTD Crown Victoria, 5.0 liter, V-8 fuel injected
1983 Oldsmobile Custom Cruiser, 5.0 liter, V-8

Three typical 6.0 gm standard (1978-80 model year) vehicles were selected.

1979 Ford Pinto, 2.3 liter, 4-cylinder
1980 Chevrolet Citation 2.8 liter, V-6
1979 Oldsmobile Cutlass, 3.8 liter, V-6

All of these vehicles were equipped with automatic transmissions. A more detailed description of each vehicle, including its evaporative emission family, is given in Tables B-1 and B-2 of Appendix B. Each vehicle was set to manufacturer's specifications prior to the start of testing. The vehicles were obtained from several sources including in-use, rental, and EPA test vehicles

4.0 Test Results Overview - Evaporative Emissions, Exhaust Emissions and Fuel Economy

The test results for each vehicle are given in the two test result listings in Appendix C. A test matrix which summarizes the test sequences done on each vehicle is also given in Appendix C.

Exhaust emissions (HC, CO, and NO_x) and fuel economy were not significantly altered by the changes in fuel for the tests using the FTP driving cycle. Exhaust emissions and fuel economy for the modified cycles were consistent with the FTP results.

Evaporative emissions for each test are also given in the same listings. These results are summarized in Tables I through IV and discussed below for each test sequence.

4.1 Test Results - RVP Effects on Vehicle

The evaporative test results are summarized in Table I and compared in Tables II and Figure 1. The testing showed that the higher volatility (higher RVP) of the commercial fuel (RVP 11.7 psi for commercial vs. 9.0 for Indolene) caused a significant increase in evaporative emissions. In

most cases the changes occurred largely in the diurnal portion of the test. Diurnal emissions with commercial fuel were typically three times the level with Indolene. Hot soak emissions with commercial fuel were 30% above the Indolene levels for the 2.0 gm vehicles and were three times the Indolene levels for the 6.0 gm vehicles.

However, individual vehicles showed marked departures from these overall trends. The Escort evaporative emissions were not affected by the fuel change. The diurnal emissions of the 1983 Oldsmobile were seven times higher due to the increase in fuel RVP. The hot soak emissions of the 1980 Citation with commercial fuel were almost four times the level with Indolene.

All three 6.0 gm standard vehicles and three of the five 2.0 gm standard vehicles met their evaporative standard when tested with Indolene and a fourth vehicle was only 25 percent above the standard. Also, although evaporative emissions increased when these vehicles were tested with commercial fuel, four of these (three 2.0 gm and one 6.0 gm vehicle) were still below the 2.0 gm standard.

The individual test results are further compared in Figure 1. Except for the two Oldsmobiles, the test results are repeatable.

Table I
Summary of Results from the FTP Evaporative Emission Tests

Vehicle	Evaporative Standard	Test fuel/Condition	(HC) gms Diurnal	Hot Soak	Total
1981 Escort	2 gm	Indolene	.27	1.37	1.64
		Commercial	.26	1.27	1.53
1983 Reliant	2 gm	Indolene	1.13	1.34	2.46
		Commercial	2.76	1.62	4.38
		Comm/10 min road prep	4.69	1.81	6.50
1982 Citation	2 gm	Indolene (1 test)	.13	.34	.47
		Commercial	.28	.36	.64
		Comm/10 min road prep	.85	.91	1.76
1983 Crown Vic.	2 gm	Indolene	.41	.46	.87
		Commercial	.72	.58	1.30
		Comm/10 min road prep	1.25	.65	1.90
1983 Oldsmobile	2 gm	Indolene	.72	2.74	3.46
		Commercial	4.99	4.34	9.33
		Comm/10 min road prep	7.57	4.11	11.68
		Ind/Comm Blend	1.71	3.22	4.93
1979 Pinto	6 gm	Indolene/Baseline	.23	.68	.91
		Commercial	.37	.92	1.28
1980 Citation	6 gm	Indolene/Baseline (3 tests)	1.35	4.44	5.79
		Commercial	4.41	16.76	21.16
		Comm/10 min road prep	4.72	22.46	27.18
		Ind/Comm Blend	1.80	8.46	10.26
1979 Cutlass	6 gm	Indolene/Baseline	1.89	1.78	3.67
		Commercial (3 tests)	7.16	1.66	8.83
		Ind/Comm Blend	2.06	1.71	3.77
Mean Evap for above five 2.0 gm vehicles		Indolene/Baseline	.53	1.25	1.78
		Commercial	1.80	1.63	3.44
Mean Evap for above three 6.0 gm vehicles		Indolene/Baseline	1.16	2.30	3.46
		Commercial	3.98	6.45	10.42
Mean Evap for above 8 vehicles		Indolene/Baseline	.77	1.64	2.41
		Commercial	2.62	3.44	6.06
Mean Evap for above excluding the two vehicles showing the greatest increase (1983 Olds & 1980 Citation)		Indolene/Baseline	.68	1.00	1.67
		Commercial	1.93	1.07	2.99

Note: Test results are the average for the duplicate (and in a few cases triplicate) tests conducted on each vehicle. The 1982 Citation was tested only once for baseline.

Table II
Comparison of Evaporative Emissions for FTP

Vehicle	Ratio of Commercial/Indolene Diurnal Emissions	Ratio of Commercial/Indolene Hot Soak Emissions	Ratio of Commercial/Indolene Total Emissions
1981 Escort	.96	.92	.93
1983 Reliant	2.45	1.21	1.78
1982 Citation	2.12	1.06	1.35
1983 Crown Vic.	1.76	1.17	1.49
1983 Oldsmobile	6.93	1.59	2.70
1979 Pinto	1.59	1.35	1.40
1980 Citation	3.27	3.78	3.66
1979 Cutlass	3.74	.94	2.41
Mean for above five 2.0 gm vehicles	3.39	1.31	1.93
Mean for above three 6.0 gm vehicles	3.43	2.80	3.01
Mean for above 8 vehicles	3.40	2.10	2.51
Mean for above excluding the two vehicles showing the greatest increase (1983 Olds and 1980 Citation)	2.84	1.07	1.79

Note: Ratios for above means were calculated using corresponding means from Table I

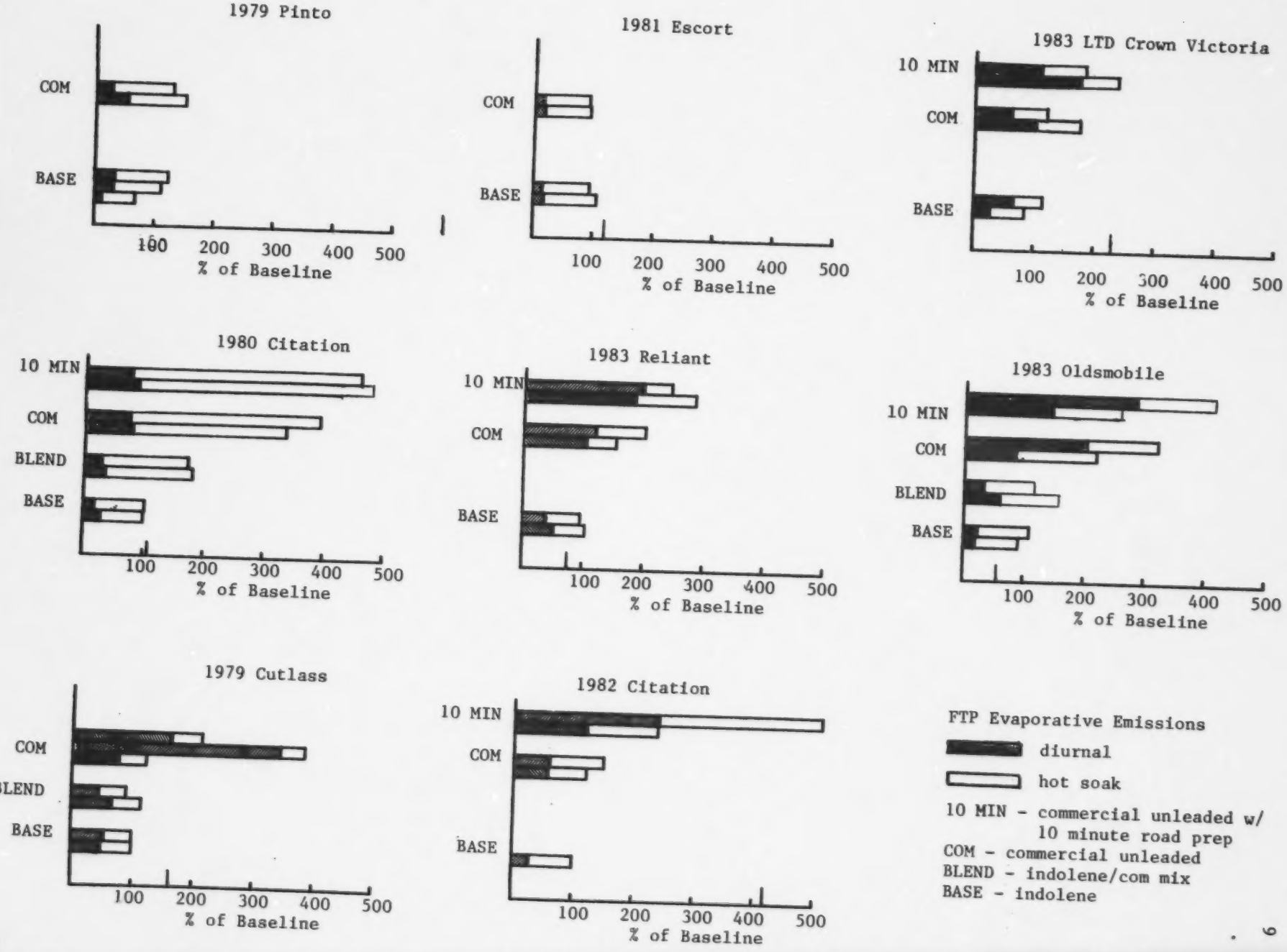

Figure 1 FTP Evaporative Emission Results

4.2 Test Results - RVP Effects on a Vehicle Using Commercial Fuel Using 10 Minute Road Prep

Five of the vehicles were retested with commercial fuel but using a 10 minute road prep in lieu of the normal LA-4 dynamometer prep. The evaporative results are also summarized in Table I and compared in Table III. These tests showed a 30 percent increase in evaporative emissions due solely to the change in vehicle prep. Most of this change was due to the increase in diurnal evaporative emissions.

Table III
Comparison of Evaporative Emissions for FTP
Using LA-4 and 10 Minute Road Prep Cycles

Vehicle	Ratio of Comm. 10 min road/LA-4 Diurnal Emissions	Ratio of Comm. 10 min road/LA-4 Hot Soak Emissions	Ratio of Comm. 10 min road/LA-4 Total Emissions
1983 Reliant	1.70	1.12	1.48
1982 Citation	3.04	2.53	2.75
1983 Crown Vic.	1.74	1.12	1.46
1983 Oldsmobile	1.52	.94	1.25
1980 Citation	1.07	1.25	1.22
Mean for above five vehicles	1.45	1.27	1.33
Mean for above four 2.0 gm vehicles (excludes 80 Citation, a 6.0 gm vehicle)	1.99	1.15	1.59

4.3 Test Results - RVP Effects of Indolene/Commercial Blend

The preceding testing showed that, while all of the vehicles maintained reasonable evaporative emission control on Indolene, the results on commercial fuel were mixed. That is, some maintained control, some did not, and some had high variability. Thus, only the vehicles which showed both large and repeatable increases with commercial fuel were tested with the blend of commercial and Indolene. The fuel was a 50/50 blend of Indolene and commercial unleaded and had a RVP midway between these of 10.4 psi.

The evaporative results are summarized in Table I and compared in Table IV. Although the results fell between those tests with Indolene and commercial, the results were much closer to the Indolene levels. This indicates that, although the evaporative emisions increase with increases in RVP, the increases may be nonlinear (see Table IV).

Table IV
Comparison of Evaporative Emissions
for FTP With Three Fuels

Vehicle/Fuel	Ratio of test fuel/Indolene Diurnal Emissions	Ratio of test fuel/Indolene Hot Soak Emissions	Ratio of test fuel/Indolene Total Emissions
1983 Oldsmobile			
Indolene	1.00	1.00	1.00
Blend	2.38	1.18	1.42
Commercial	6.93	1.59	2.70
1980 Citation			
Indolene	1.00	1.00	1.00
Blend	1.33	1.91	1.77
Commercial	3.27	3.78	3.66
1979 Cutlass			
Indolene	1.00	1.00	1.00
Blend	1.09	.96	1.03
Commercial	3.74	.94	2.41

4.4 Test Results - RVP Effects on Vehicle With Modified Driving Cycles

The in-use vehicle testing program incorporates a ten minute road prep instead of the LA-4 prep. This was done to reduce test costs, to simplify procedures, and to prep with a cycle of shorter time. Because the testing with a 10 minute road prep indicated that there was a difference and since available data indicates that the median trip time is slightly over 10 minutes* rather than the 23 minutes of the LA-4, it was decided to investigate the problem further using a dynamometer driving cycle slightly greater than ten minutes.

Therefore, two test cycles were derived from the LA-4 driving schedule. They were selected to emphasize the lower and higher speed segments of the LA-4. The Low Speed Cycle is from 625 to 1251 seconds of the LA-4, takes 10.4 minutes to drive, and is 3.02 miles long. The Moderate Speed cycle is from 0 to 630 seconds of the LA-4, takes 10.5 minutes to drive, and is 4.04 miles long. These cycles are described in greater detail and compared to the LA-4 and HFET in Table B-3.

The five late model vehicles were retested with commercial fuel using these new cycles. The procedures followed the standard FTP procedure except that the new test cycle was used for both the prep and test cycles (e.g., low speed prep with low speed test or moderate speed prep with moderate speed test). For each test cycle the vehicle was preconditioned with a 125 mile road route and then tested twice using the test cycle.

* "A Survey of Average Driving Patterns in Six Urban Areas of the United States. Summary Report "TM-(L)-4119/007/00, Systems Development Corporation, January 29, 1971

The exhaust emissions were consistent with the previous FTP results. These test results are tabulated in Appendix C and the evaporative results are summarized in Table V. To facilitate comparisons between the two cycles (low and mod speed) and the previous testing with commercial fuel (FTP w/LA-4 prep and FTP w/10 min road prep), the evaporative emission results in Tables I and V are retabulated in Table VI for these five vehicles.

Table V
Summary of Results from the Short Cycle
Evaporative Emission Tests

Vehicle	Evaporative Standard	Test Condition	(HC) gms		
			Diurnal	Hot Soak	Total
1981 Escort	2 gm	low spd-A	.69	.95	1.64
		mod spd-B	.29	1.12	1.41
1983 Reliant	2 gm	low spd-A	4.17	1.03	5.20
		mod spd-B (3 tests)	2.20	1.10	3.30
1982 Citation	2 gm	low spd-A	.93	.97	1.89
		mod spd-B	.90	.69	1.59
1983 Crown Vic.	2 gm	low spd-A	2.15	.55	2.70
		mod spd-B (1 test)	3.01	.55	3.56
1983 Oldsmobile	2 gm	low spd-A	1.56	2.63	4.18
		mod spd-B (3 tests)	2.01	2.93	4.94
Mean for above five vehicles		low spd-A	1.90	1.23	3.12
		mod spd-B	1.68	1.28	2.96

Low Spd-A - low speed, cycle A - portion of LA-4 driving cycle from 625 to 1251 seconds (10.4 minutes), 3.02 miles.

Mod Spd-B - moderate speed, cycle B - portion of LA-4 driving cycle from 0 to 630 seconds (10.5 minutes), 4.04 miles.

Note: Test results are the average for the duplicate (and in a few cases, triplicate) tests conducted on each vehicle. The 1983 LTD Crown Victoria was tested only once for the moderate speed cycle due to vehicle mechanical problems.

Table VI
Summary of Commercial Unleaded Fuel Tests
From Tables I and V

Vehicle	Test Condition	HC (gms) Diurnal	Hot Soak	Total
1981 Escort	FTP w/LA-4 prep	.26	1.27	1.53
	FTP w/10 min road prep	-	-	-
	low spd-A for test & prep	.69	.95	1.64
	mod spd-B for test & prep	.29	1.12	1.41
1983 Reliant	FTP w/LA-4 prep	2.76	1.62	4.38
	FTP w/10 min road prep	4.69	1.81	6.50
	low spd-A for test & prep	4.17	1.03	5.20
	mod spd-B for test & prep	2.20	1.10	3.30
1982 Citation	FTP w/LA-4 prep	.28	.36	.64
	FTP w/10 min road prep	.85	.91	1.76
	low spd-A for test & prep	.93	.97	1.89
	mod spd-B for test & prep	.90	.69	1.59
1983 Crown Vic	FTP w/LA-4 prep	.72	.58	1.30
	FTP w/10 min road prep	1.25	.65	1.90
	low spd-A for test & prep	2.15	.55	2.70
	mod spd-B for test & prep	3.01	.55	3.56
1983 Oldsmobile	FTP w/LA-4 prep	4.99	4.34	9.33
	FTP w/10 min road prep	7.57	4.11	11.68
	low spd-A for test & prep	1.56	2.63	4.18
	mod spd-B for test & prep	2.01	2.93	4.94
Means for above five vehicles	FTP w/LA-4 prep	1.80	1.63	3.44
	FTP w/10 min road prep	3.59	1.87	5.46
	low spd-A for test & prep	1.90	1.23	3.12
	mod spd-B for test & prep	1.68	1.28	2.96

It appears there is no appreciable difference in the diurnal or hot soak emissions for this fleet of five vehicles between these two tests or those using LA-4 preps on the dynamometer. However, as noted in Section 4.2, the tests with a road prep did not follow this trend.

Individual vehicles did show marked differences for these new test cycles (e.g., Reliant low speed diurnal emissions were twice the moderate speed diurnal emissions) but no consistent pattern was evident (e.g., Crown Victoria showed opposite effect of Reliant on diurnal emissions). Hot soak emissions were relatively unaffected by the two cycles.

4.5 Test Results - Carry Over Evaporative Emission Test Results

Vehicles received extended road preconditioning between tests with different fuels so as to eliminate any influence one fuel might have on the results using another fuel. However, since it was desired to keep this type of preconditioning as short as possible, the in-use test programs would test vehicles with both Indolene and commercial fuel without a vehicle preconditioning. Thus, it was desirable to quantify any carry over effect. Therefore, one vehicle was used for a three test FTP sequence to check on this potential problem.

Accordingly, the Reliant was tested using Indolene, then commercial, and then Indolene to investigate this problem. There were no appreciable differences in the exhaust emissions. The evaporative results are tabulated in Table VII. From these results it appears that there are no carry over effects. The differences observed are within normal test-to-test variability.

Table VII
Carry Over Evaporative Emission Test Results

Vehicle	Evaporative Standard	Test Fuel	HC (gms)		
			Diurnal	Hot Soak	Total
1983 Reliant	2 gm	Indolene	1.47	1.25	2.72
		Commercial	2.87	1.33	4.20
		Indolene	1.08	1.23	2.31

4.6 Test Results - Continuous Measurement of HC Levels During Diurnal and Hot Soak Tests

A Flame Ionization Detector (FID) is used to measure the HC levels in the SHED at the beginning and end of both the diurnal and hot soak segments of the evaporative test. These values are used to calculate the HC evaporative mass emissions. For these tests the FID was used to continuously monitor the HC levels throughout both the diurnal and hot soak portions of the evaporative test to determine if and when canister "breakthrough"* occurred. On most tests, HC emissions increased at a relatively constant rate throughout the one hour test periods of both the diurnal and hot soak. This pattern was seen in tests at all emission levels.

4.7 Test Results - Comparison of Thermocouple Measurement Techniques

To test for diurnal evaporative emisions, the vehicle is fueled with chilled fuel to 40 percent of tank capacity. The vehicle then undergoes a heat build in the SHED to raise the fuel temperature from 60°F to 84°F in one hour at a constant rate of increase.

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* Breakthrough refers to a condition where the rate of increase in HC levels in the SHED increases markedly due to the overloading of the evaporative control system of the vehicle.

The fuel temperature of a certification vehicle is measured with a thermocouple permanently mounted in the fuel tank at a proper height. To install the thermocouple, the tank must be removed and purged. To avoid this removal and purging of the fuel tank of test vehicles, the thermocouple is installed through the fuel cap or attached to the exterior of the tank.

For this testing, fuel temperature was monitored by means of a thermocouple installed through the fuel cap. However, our large in-use test programs use external thermocouples to preclude the need for extra fuel caps and the risk of venting the fuel vapors through an incompletely sealed thermocouple wire through the cap.

To gain experience with the use of external tank versus internal tank (through the cap) fuel temperature measurements, both temperatures were monitored during the latter stages of this test program. For these tests, the fuel tank surface was cleaned to bare metal at the midpoint of the 40% fuel fill. A thermal conducting paste was applied to the surface and the thermocouple was then taped to the tank.

Typically, the externally mounted thermocouple initially read 2°F higher than the internal one. However, the two were usually equal after 50 minutes of the heat build and within a degree after one hour (at this time the internal temperature was usually slightly higher than the external temperature). In those few instances where there was an improper thermal bonding of the thermocouple to the tank, the problem was immediately evident since the initial temperature of the external thermocouple exceeded the initial temperature limit of the fuel.

4.8 Test Results - Measurement of the RVP of the Fuels

Throughout the test program the RVP of the test fuels was checked. Fuel samples from the underground tank were obtained by lowering a sample bottle into the tank. Fuel samples from the hose of the fuel cart were obtained by first pumping out a half gallon of fuel to put fresh fuel in the hose and then putting the nozzle into the sample bottle. Fuel samples from the fuel cart and vehicles were obtained by the positive displacement of water method in the sample bottle. This bottle was chilled in an ice bath to reduce loss of the lighter hydrocarbons of the fuel while obtaining the sample. The fuel samples were tested for RVP by using ASTM procedure D323.

In order to monitor the RVP of the fuel throughout the fuel handling process, fuel samples were taken from the underground tanks, the refueling cart*, and the vehicle fuel tanks. The underground tanks were sampled only once or twice since prior experience had shown the results were repeatable over a several month period. The refueling cart was sampled after each refilling of the cart. Also, samples were taken from the vehicle fuel tanks to determine RVP changes during vehicle refueling.

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* Test fuel was pumped from the underground tank to a refueling cart. The cart chilled the fuel for the diurnal heat build.

The RVP test results are tabulated in Table VIII and plotted in Figure 2. The refueling cart samples are listed in the order sampled. It was immediately evident that there was an appreciable drop in the RVP of the commercial fuel sample taken from the hose. However, samples from the cart showed only a small decrease. To determine if this was unique to the hose sample and if the vehicle fuel in the vehicle experienced a similar loss, vehicle fuel tank samples were also taken. The Crown Victoria and Cutlass showed a loss in RVP of about .7 psi (from the cart), the remaining vehicles experienced changes ranging from 0 to .3 psi. The change in RVP was considerably less with the blended fuel, being 0 psi on two vehicles and .5 psi on the other tested.

Table VIII
RVP of Fuel at Noted Locations (psi)

Fuel	Underground tank	Refueling Cart	Vehicle Fuel Tank	
Commercial Unleaded	11.70	10.70 (from hose)	Escort	11.5
	11.60	10.10 (from hose)	Reliant	11.35
		11.35	82 Citation	11.50
		11.50	Crown Vic.	10.80
		11.00 (from hose)	"	11.10
		11.55	Custom Cruiser	11.20
		11.60 (from hose)	Pinto	11.50
		11.70 (from hose)	80 Citation	11.15
		11.60	Cutlass	10.70
		11.40	"	10.75
		11.10		
		11.60		
		11.70		
		11.50		
Blend		10.60	Cruiser	9.70
		10.35	80 Citation	10.45
		10.25	Cutlass	10.25
		10.35		
		10.30		
Indolene	9.0		Cruiser	8.90
			80 Citation	8.85
			Cutlass	8.80

Note: There is not a one-to-one correlation between all of the above values, e.g., the refueling cart was refilled and checked for RVP numerous times and each fill was sufficient for four to six vehicle tests. Thus, although the cart values given are in chronological order, they do not necessarily represent the RVP of the fuel in the vehicle fuel tank on the same line.

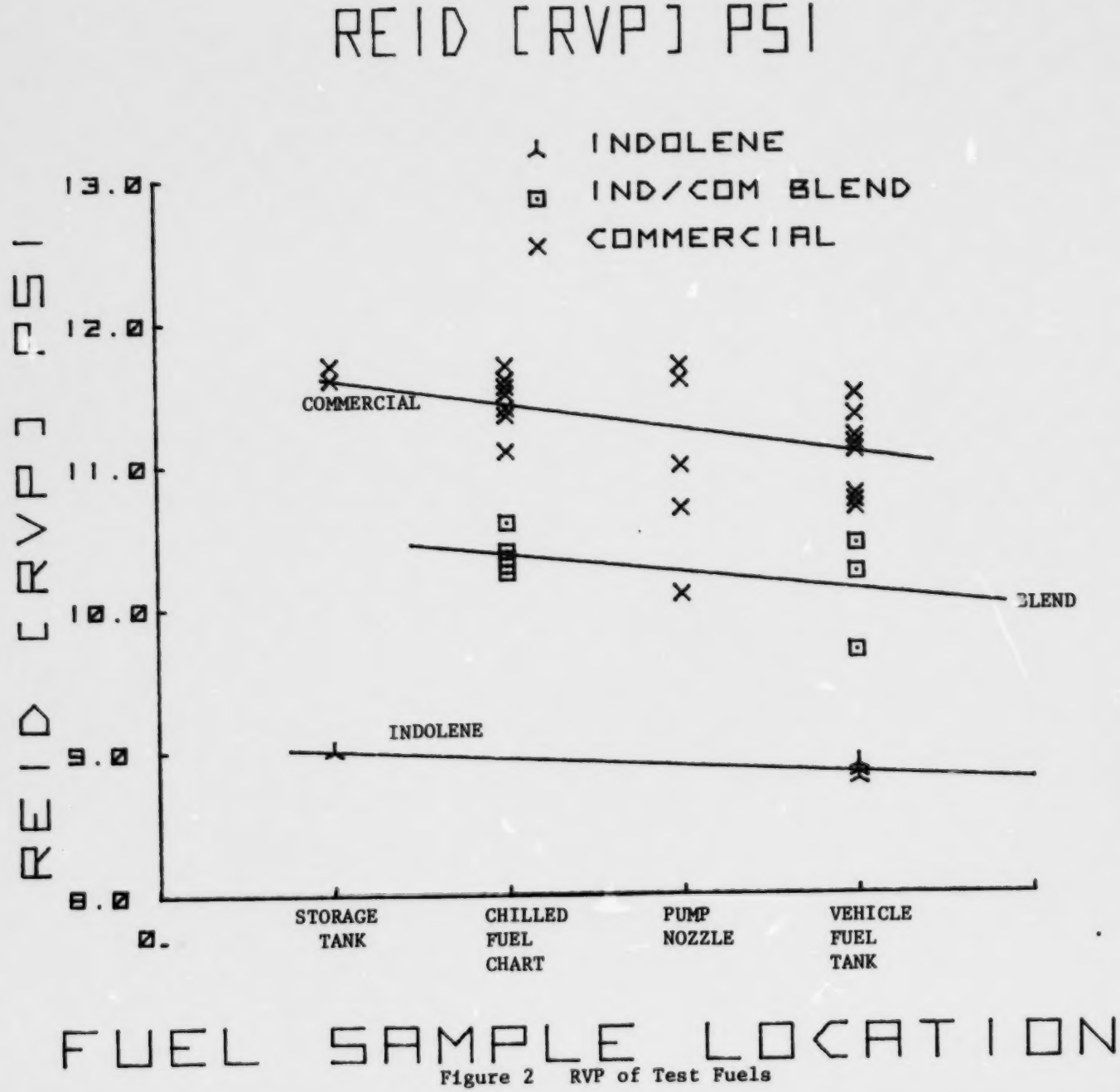

Figure 2 RVP of Test Fuels

These changes noted in the RVP of the commercial fuel in vehicle tanks did not correlate with the changes in emissions. The Crown Victoria and Cutlass showed the largest RVP changes due to refueling but the Crown maintained good evaporative control while the Cutlass did not. The 80 Citation showed very little RVP change, yet was the poorest vehicle in maintaining total emission control.

5.0 Summary of Findings

The increase in fuel RVP significantly increased evaporative emissions. For the group of vehicles, diurnal emissions with commercial fuel were three times the level with Indolene. Hot soak emissions with commercial fuel were 30% above the Indolene levels for the 2.0 gm vehicles and were three times the Indolene levels for the 6.0 gm vehicles.

The use of a 10 minute road prep in lieu of the LA-4 dynamometer prep further increased the evaporative emissions of the commercial fuel. Most of this change occurred in the diurnal emissions and was therefore probably due to incomplete purging of the canister during the prep.

The 50/50 blend of Indolene and commercial unleaded had a RVP of 10.4 which was midway between these fuels. However, although the evaporative emission results fell between those with Indolene and commercial, the results were much closer to the Indolene levels. This indicated that although the evaporative emissions increase with increases in RVP, the increases may be non-linear.

Differences in diurnal evaporative emissions were noted for both of the two 10 minute modified driving cycles derived from the 23 minute LA-4. However, no consistent overall pattern was evident. Hot soak emissions were relatively unaffected by these two cycles.

There was no noticeable carry over effect between the two fuels for the one vehicle tested.

The changes in fuel types/RVP did not cause a significant change in exhaust emissions or fuel economy.

The continuous monitoring of HC levels during the SHED test showed very few cases of HC "breakthrough." This pattern was seen in tests at all emission levels.

External thermocouples appeared to reasonably track thermocouples installed through the fuel cap.

During refueling, some vehicles experienced a relatively large change in fuel tank RVP, whereas others experience very little. Unlike the changes in fuel RVP due to change in fuel, the changes in RVP during refueling did not correlate with the changes in evaporative emissions.

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Test Sequence
RVP Effects on Vehicle

1. Check vehicle.

2. Drain vehicle and refuel with Indolene.

3. Road preconditioning - #1 Adrian Road Route (a 125 mile road route).

The standard evaporative emission test consists of Steps 4 through 10 below:

4. Drain and 40% refuel with Indolene.

5. Dynamometer prep using LA-4 driving cycle.

6. Standard soak (a minimum of 12 hours to a maximum of 36 hours).

7. Drain and 40% refuel with chilled Indolene.

8. Diurnal evaporative emissions test (one hour soak in SHED enclosure, fuel is heated from 60°F to 84°F).

9. Test using FTP (uses LA-4 driving cycle with repeat of first half of cycle).

10. Hot soak evaporative emissions test (one hour soak in SHED enclosure).

11. Repeat numbers 4 through 10 above.

12. Repeat numbers 2 through 11 above using commercial unleaded.

Notes: All tests use Indolene unleaded for first two tests and commercial unleaded for next two.

Test vehicles for this test sequence are given below. Detailed descriptions of these vehicles are given in Tables V and VI.

1981 Ford Escort
1983 Plymouth Reliant
1982 Chevrolet Citation
1983 Ford Crown Victoria
1983 Oldsmobile Custom Cruiser
1979 Ford Pinto
1980 Chevrolet Citation
1979 Oldsmobile Cutlass

Test Sequence
RVP Effects on a Vehicle Using a 10 Minute Road Prep

1. Start sequence after standard tests with commercial unleaded.
2. Drain vehicle and 40% refuel with commercial unleaded.
3. Road prep - 10 minute road route.
   (no dynamometer prep)
4. Standard soak.
5. Drain and 40% refuel with chilled commercial unleaded.
6. Diurnal evaporative emissions test.
7. Test using FTP.
8. Hot soak evaporative emissions test.
9. Repeat numbers 2 through 8 above.

Test vehicles for this test sequence are given below. Detailed descriptions of these vehicles are given in Tables V and VI.

1983 Plymouth Reliant
1982 Chevrolet Citation
1983 Ford Crown Victoria
1983 Oldsmobile Custom Cruiser
1980 Chevrolet Citation

Test Sequence
RVP Effects of Indolene/Commercial Blend

1. Check vehicle.
2. Drain vehicle and refuel with blended test fuel.
3. Road preconditioning - #1 Adrian Road Route (a 125 mile road route).
4. Drain and 40% refuel with blended fuel.
5. Dynamometer prep with LA-4.
6. Standard soak.
7. Drain and 40% refuel with chilled blended fuel.
8. Diurnal evaporative emissions test.
9. Test using FTP.
10. Hot soak evaporative emissions test.
11. Repeat numbers 4 through 10 above.

Test vehicles for this test sequence are given below. Detailed descriptions of these vehicles are given in Tables V and VI.

1983 Oldsmobile Custom Cruiser
1980 Chevrolet Citation
1979 Oldsmobile Cutlass

Test Sequence
RVP Effects on Vehicle Using Modified Driving Cycles

1. Drain vehicle and refuel with commercial unleaded.
2. Road preconditioning - #1 Adrian Road Route (a 125 mile road route).
3. Drain and 40% refuel with commercial unleaded.
4. Dynamometer prep with Low Speed Cycle (test cycle A).
5. Standard soak.
6. Drain and 40% refuel with chilled commercial unleaded.
7. Diurnal evaporative emissions test.
8. Test using Low Speed Cycle.
9. Hot soak evaporative emissions test.
10. Repeat numbers 3 through 9 above.
11. Repeat numbers 1 through 10 above using Moderate Speed Cycle (test cycle B).

Notes: All tests use commercial unleaded gasoline.

Low Speed Cycle - LA-4 driving cycle from 625 to 1251 seconds, 3.02 miles.

Moderate Speed Cycle - LA-4 driving cycle from 0 to 630 seconds, 4.04 miles.

Test vehicles for this test sequence are given below. Detailed descriptions of these vehicles are given in Tables V and VI.

1981 Ford Escort
1983 Plymouth Reliant
1982 Chevrolet Citation
1983 Ford Crown Victoria
1983 Oldsmobile Custom Cruiser

Carry Over Test Sequence
RVP Evaporative Emission Effects

1. Vehicle delivered.
2. Drain vehicle and 40% refuel with Indolene.
3. Ten minute dynamometer prep, moderate speed - cycle B.
4. Standard soak.
5. Drain and 40% refuel with chilled Indolene.
6. Diurnal evaporative emissions test.
7. Test using FTP.
8. Hot soak evaporative emissions test.
9. Repeat numbers 2 through 8 above using commercial unleaded.
10. Repeat numbers 2 through 8 above using Indolene.

Moderate speed, cycle B - LA-4 from 0 to 630 seconds, 10.5 minutes, 4.04 miles.

The test vehicle for this test sequence is the 1983 Plymouth Reliant described in Table V.

Table B-1
Test Vehicle Description
2.0 Gram Evaporative Standard Vehicles

Make/Model	Ford Escort	Plymouth Reliant	Chevrolet	Ford LTD Crown Vic.	Olds Custom Cruiser
Model Year	1981	1983	1982	1983	1983
Type	2 dr hatchback	4 dr sedan	4dr hatchback	4dr sedan	station wagon
Veh. ID	1FABP0524BW158832	1P3BP26C9DF251538	1G1AX68R6CT102873	2FABP432DB148513	1G3AP35Y5DX34364
In. Odom.	29900 miles	2500 miles	35200 miles	10700 miles	22400 miles
Engine					
Type	Spark Ignition	Spark Ignition	Spark Ignition	Spark Ignition	Spark Ignition
Config.	transverse 4	transverse 4	transverse 4	V-8	V-8
Disp.	1.6 liters	2.2 liters	2.5 liters	5.0 liters	5.0 liters
Fuel Met.	2V Carb	2V Carb	Fuel Injection	Fuel Injection	4V Carb
Eng. Fam	1.6AP	DCR2.2V2HAC3	C2G2.5V5TPG5	DFM5.0V5HLF8	D3G5.0V4ARA9
Evap. Fam	CM	DCRKA	2BO-2A	3FQ	3B4-3A
Emission Control System	EGR 3-way cat. air pump	EGR 3-way cat closed loop oxid. cat. air pump	EGR 3-way cat closed loop	EGR 3-way cat. closed loop oxid. cat. air pump	EGR 3-way cat. closed loop oxid. cat. air pump
Trans.	automatic 3-speed	automatic 3-speed	automatic 3-speed lock-up	automatic 4-speed lock-up	automatic 4-speed lock-up
Tires	P155/80R13	P175/75R13	P185/80R13	P215/75R14	P225/75R15
Test Para.					
inertia wt	2375 lbs.	2750 lbs.	3000 lbs.	4250 lbs.	4750 lbs.
HP @ 50 mph	6.4hp	8.0hp	7.3hp	12.8hp	12.7hp

Table B-2
Test Vehicle Description
6.0 Gram Evaporative Standard Vehicles

Make/Model	Ford Pinto	Chev Citation	Olds. Cutlass Supreme
Model Year	1979	1980	1979
Type	2 dr hatchback	4 dr hatchback	2 dr hardtop
Vehicle ID	9T11Y186165	1Y687AW139507	3R47A9M523280
Initital Od.	26750 miles	37030 miles	37700 miles
Engine:			
Type	Spark Ignition	Spark Ignition	Spark Ignition
Config.	In-line 4	Transverse V-6	V-6
Disp.	2.3 liters	2.8 liters	231 CID
Fuel Metering	2V Carb.	1V Carb.	2V Carb.
Engine Fam.	2.3A1X92EGR/CAT	01C2EY2.8L	3.8L940B2
Evap. Fam.	B	0B6-1	9B3-4
Emission Cont. System	EGR Oxid. Cat. Pulse Air	EGR Oxid. Cat. Pulse Air	EGR Oxid. Cat. Pulse Air
Transmission	Automatic 3 speed	Automatic 3 speed	Automatic 3 speed
Tires	BR78X13	P185/80R13	P195/75R13
Test Parameters:			
Inertia Wt.	2750 lbs	3000 lbs	3500 lbs
HP @ 50 MPH	9.7hp	7.3hp	9.5hp

Table B-3
Comparison of Two 10 Minute Cycles
With Standard Cycles

Cycle	Length Miles	Average Speed (MPH)	Top Speed (MPH)	# of Modes	% Time Idle	Cycle Time Seconds
Low Speed (Cycle A)	3.02	17.4	34.3	9(1)	16.9%	626
Moderate Speed (Cycle B)	4.04	23.1	56.7	7(2)	20.6%	630
Bag(1) LA-4	3.59	25.6	56.7	5	18.8%	505
Bag(2) LA-4	3.91	16.2	34.3	13	19.1%	867
LA-4	7.45	19.7	56.7	18	19.0%	1372
HFET	10.24	48.2	59.9	1	.5%	765

(1) Modes 8 thru 16 of LA-4 (LA-4 cycle from 625 to 1251 seconds).

(2) Modes 1 thru 7 of LA-4 (LA-4 cycle from 0 to 630 seconds).

(3) Idle time equals time @1.0 mph or less.

Test Matrix for RVP Project

Car	FTP Test Status				Modified Driving Cycle		
	Baseline (Indolene)	Commercial 11.5 RVP	Commercial 10 min. prep	Blend 10 RVP	Low speed cycle(1)	Moderate speed cycle(2)	Carry Over
2.0 gm Std							
81 Escort	X	X			X	X	
83 Reliant	X	X	X		X	X	X
82 Citation	X	X	X		X	X	
83 Crown Victoria	X	X	X		X	X	
83 Olds	X	X	X	X	X	X	
6.0 gm Std.							
79 Pinto	X	X					
80 Citation	X	X	X	X			
79 Cutlass	X	X		X			

(1) Low speed cycle-LA-4 from 625 to 1251 seconds, 10.4 minutes, 3.02 miles.

(2) Moderate speed cycle-LA-4 from 0 to 630 seconds, 10.5 minutes 4.04 miles.

FTP - Baseline, Commercial, 10 Minute Road Prep and Blenc

VEHICLE.ID 1FABP0524BW15883 1981 FORD ESCORT
TEST.PROCEDURE CVS.75-LATR

TEST.NUMBER	TEST.DATE	TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
840645	03-83-11	BASE.CONFIG	30044.0	2.47538	94.6267	.6144	21.5478	.30	1.45	1.74
840646	05-83-11	BASE.CONFIG	30073.6	2.30295	93.0661	.5605	21.8664	.24	1.29	1.53
840397	07-83-11	COMM.UNLEAD	30227.0	2.39867	94.3369	.5757	21.7431	.28	1.26	1.54
840396	08-83-11	COMM.UNLEAD	30247.0	2.32125	87.4842	.5470	22.6325	.24	1.27	1.51

VEHICLE.ID 1G1AX68R6CT10287 1982 CHEVROLET CITATION
TEST.PROCEDURE CVS.75-LATR

TEST.NUMBER	TEST.DATE	TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
840723	07-83-11	BASE.CONFIG	35350.0	.18280	2.9754	.3287	28.0403	.13	.34	.47
840781	10-83-11	COMM.UNLEAD	35520.0	.17844	4.6254	.4518	28.0778	.27	.30	.57
840799	15-83-11	COMM.UNLEAD	35539.0	.18279	3.9200	.3748	28.1760	.28	.42	.70
841064	23-83-11	COMM.10.MIN	35556.0	.21315	5.0528	.4204	30.7268	.57	.55	1.12
841128	29-83-11	COMM.10.MIN	35574.0	.18791	3.9304	.3772	27.7326	1.13	1.27	2.40

VEHICLE.ID 1G3AP35Y5DX34364 1983 OLDSMOBILE CUSTOM CRUISER
TEST.PROCEDURE CVS.75-LATR

TEST.NUMBER	TEST.DATE	TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
840862	17-83-11	BASE.CONFIG	22532.0	.37687	2.9628	.7816	15.9830	.65	2.49	3.15
840863	18-83-11	BASE.CONFIG	22551.0	.34629	3.3397	.8008	15.7698	.79	2.98	3.76
840864	22-83-11	COMM.UNLEAD	22703.0	.41936	3.3322	.7721	16.0491	2.98	4.60	7.58
840865	23-83-11	COMM.UNLEAD	22721.0	.00000	.0000	.0000	.0000	7.00	4.08	11.08
841148	01-83-12	COMM.10.MIN	22744.0	.38637	2.8488	.7015	16.2211	5.11	3.89	9.00
841158	02-83-12	COMM.10.MIN	22760.0	.39988	3.8110	.7427	16.4146	10.02	4.33	14.35
841187	06-83-12	IND/COM.MIX	22909.0	.40835	3.3299	.6952	16.4064	2.07	3.51	5.58
841188	07-83-12	IND/COM.MIX	22928.0	.38462	2.8515	.7164	16.3709	1.35	2.93	4.28

VEHICLE.ID 1P3BP26C9DF25153 1983 PLYMOUTH RELIANT
TEST.PROCEDURE CVS.75-LATR

TEST.NUMBER	TEST.DATE	TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
840383	20-83-10	BASE.CONFIG	2632.0	.14653	1.5161	.6649	25.0614	1.28	1.27	2.55
840384	21-83-10	BASE.CONFIG	2651.0	.15812	1.6924	.6670	25.1823	.97	1.40	2.37
840385	26-83-10	COMM.UNLEAD	2814.0	.26237	3.1953	.7065	25.5669	2.58	1.20	3.79
840387	31-83-10	COMM.UNLEAD	2841.0	.29027	3.8293	.7484	24.7065	2.94	2.03	4.97
840386	05-83-11	COMM.10.MIN	2858.0	.25377	3.5948	.7733	24.8096	4.52	2.47	6.99
840390	07-83-11	COMM.10.MIN	2876.0	.30415	3.1396	.4695	29.9701	4.86	1.14	6.00
841743	06-83-01	BASE.CONFIG	3043.0	.18471	1.8202	.7858	22.5970	1.47	1.25	2.72
841744	09-84-01	COMM.UNLEAD	3446.0	.19730	2.2543	.7895	24.5545	2.87	1.33	4.20
841745	10-84-01	BASE.CONFIG	3462.1	.17931	1.6136	.8202	24.4235	1.08	1.30	2.38

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VEHICLE.ID 1X687AW139507 1980 CHEVROLET CITATION
TEST.PROCEDURE CVS.75-LATR

TEST.NUMBER	TEST.DATE	TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
840176	07-83-10	BASE.CONFIG	37184.0	.40111	3.3814	1.1940	19.5512	1.37	4.05	5.42
840177	12-83-10	BASE.CONFIG	37203.0	.43229	3.6346	1.0957	19.8359	1.63	4.10	5.73
840178	14-83-10	BASE.CONFIG	37222.0	.39295	2.6738	1.2182	19.8639	1.07	4.77	5.84
840080	02-83-11	COMM.UNLEAD	37386.0	.42608	3.1988	1.0796	19.6903	4.56	14.98	19.53
840179	03-83-11	COMM.UNLEAD	37408.0	.43251	3.7431	1.0767	19.5225	4.26	18.53	22.79
840180	05-83-11	COMM.10.MIN	37425.0	.51067	4.5455	1.0598	19.8939	5.04	22.66	27.70
840379	07-83-11	COMM.10.MIN	37442.0	.42059	3.9697	.9762	19.8137	4.39	22.26	26.65
840776	10-83-11	IND/COM.MIX	37590.0	.00000	.0000	.0000	.0000	1.98	8.47	10.45
840855	16-83-11	IND/COM.MIX	37611.0	.42061	4.4145	1.1327	19.9613	1.61	8.45	10.06

VEHICLE.ID 2FABP43F2DB14851 1983 LTD CROWN VICTORIA
TEST.PROCEDURE CVS.75-LATR

TEST.NUMBER	TEST.DATE	TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
840643	03-83-11	BASE.CONFIG	10865.0	.31219	5.3174	.6419	15.6033	.24	.50	.74
840644	04-83-11	BASE.CONFIG	10883.0	.31205	5.9754	.6430	15.8533	.58	.42	1.00
840720	07-83-11	COMM.UNLEAD	11032.0	.35950	5.9702	.6502	16.1378	.90	.58	1.48
840742	08-83-11	COMM.UNLEAD	11054.0	.30680	6.6205	.7231	16.2308	.54	.57	1.11
840775	10-83-11	COMM.10.MIN	11070.0	.33814	6.4590	.6204	16.4461	1.53	.64	2.17
840800	15-83-11	COMM.10.MIN	11087.0	.36595	9.1289	.7285	16.2268	.97	.66	1.63

VEHICLE.ID 3R47A9M523280 1979 OLDSMOBILE CUTLASS
TEST.PROCEDURE CVS.75-LATR

TEST.NUMBER	TEST.DATE	TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
822397	30-83-09	BASE.CONFIG	37854.0	1.18670	12.8680	2.3905	18.6679	1.80	1.85	3.66
840181	04-83-10	BASE.CONFIG	37873.0	1.40030	16.7870	2.3258	18.9960	1.98	1.70	3.68
840182	06-83-10	COMM.UNLEAD	38018.0	.99930	14.9630	2.6362	19.2474	2.81	1.68	4.49
840183	27-83-10	COMM.UNLEAD	38057.0	1.28210	17.6410	2.3159	18.9199	12.65	1.48	14.13
840184	03-83-11	COMM.UNLEAD	38080.0	.95480	12.7730	2.4779	19.4421	6.03	1.83	7.86
840185	16-83-11	IND/COM.MIX	38225.0	1.42140	18.2410	2.4445	19.2741	2.46	1.76	4.22
840868	17-83-11	IND/COM.MIX	38247.0	1.27710	16.4620	2.6706	19.1128	1.65	1.66	3.31

VEHICLE.ID 9T11Y186165 1979 FORD PINTO
TEST.PROCEDURE CVS.75-LATR

TEST.NUMBER	TEST.DATE	TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
822399	30-83-09	BASE.CONFIG	26903.0	1.55980	14.4800	1.2922	21.9652	.11	.50	.62
840186	04-83-10	BASE.CONFIG	26922.0	1.60820	18.4720	1.1889	22.3841	.28	.73	1.01
840187	05-83-10	BASE.CONFIG	26941.0	1.43740	12.7650	1.4157	22.8158	.30	.81	1.11
840188	31-83-10	COMM.UNLEAD	27068.0	1.51690	14.8650	1.2898	22.4375	.48	.90	1.37
840377	01-83-11	COMM.UNLEAD	27109.0	1.43980	12.3040	1.2521	22.7448	.25	.93	1.18

Modified Driving Cycles

VEHICLE.ID 1FABP0524BW15883
TEST.PROCEDURE BAG.BY.BAG 1981 FORD ESCORT

TEST.NUMBER	TEST.DATE	ECTD.TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
840395	12-83-12	LOW.SPD-A	30410.0	2.221	51.595	.903	22.8	.51	.97	1.48
840394	15-83-12	LOW.SPD-A	30430.0	.000	.000	.000	.0	.86	.93	1.79
840398	20-83-12	MED.SPD-B	30561.0	1.491	46.278	1.176	23.5	.34	1.11	1.45
840393	22-83-12	MED.SPD-B	30573.0	.000	.000	.000		.23	1.13	1.36

VEHICLE.ID 1G1AX68R6CT10287
TEST.PROCEDURE BAG.BY.BAG 1982 CHEVROLET CITATION

TEST.NUMBER	TEST.DATE	ECTD.TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
841345	13-83-12	LOW.SPD-A	35723.0	.669	7.523	.637	24.4	1.03	.91	1.94
841346	14-83-12	LOW.SPD-A	35740.0	.000	.000	.000	.0	.82	1.02	1.84
841347	21-83-12	MED.SPD-B	35872.0	.522	9.372	.814	24.5	.62	.71	1.33
841348	04-84-01	MED.SPD-B	35889.0	.488	12.020	.771	24.7	1.18	.67	1.85

VEHICLE.ID 1G3AP35Y5DX34364
TEST.PROCEDURE BAG.BY.BAG 1983 OLDSMOBILE CUSTOM CRUISER

TEST.NUMBER	TEST.DATE	ECTD.TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
841195	09-83-12	LOW.SPD-A	23073.0	.916	13.767	.938	13.7	1.24	2.60	3.84
841196	12-83-12	LOW.SPD-A	23079.0	.869	15.914	.934	13.7	1.88	2.64	4.51
841197	16-83-12	MED.SPD-B	23221.0	.675	12.316	1.083	15.1	2.42	3.04	5.46
841198	19-83-12	MED.SPD-B	23229.0	.633	10.126	1.207	14.8	1.07	2.81	3.89
841622	10-84-01	MED.SPD-B	23258.0	.653	9.507	1.157	14.6	2.54	2.94	5.48

VEHICLE.ID 1P3BP26C9DF25153
TEST.PROCEDURE BAG.BY.BAG 1983 PLYMOUTH RELIANT

TEST.NUMBER	TEST.DATE	ECTD.TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
841199	15-83-12	LOW.SPD-A	3235.0	.975	19.489	.517	21.5	3.92	.97	4.89
841200	19-83-12	LOW.SPD-A	3241.0	.535	11.667	.584	21.8	4.41	1.09	5.51
840389	21-83-12	MED.SPD-B	3384.0	.498	11.501	.979	21.9	2.52	1.17	3.69
840388	22-83-12	MED.SPD-B	3392.0	.483	11.259	.971	22.4	2.19	1.09	3.28
841624	04-84-01	MED.SPD-B	3417.0	.382	7.299	.970	22.1	1.88	1.04	2.92

VEHICLE.ID 2FABP43F2DB14851
TEST.PROCEDURE BAG.BY.BAG 1983 LTD CROWN VICTORIA

TEST.NUMBER	TEST.DATE	ECTD.TEST.DISP	ODOMETER	HC	CO	NOX	MI/GAL	DIURNAL	HOT.SOAK	TOTAL.EVAP
841344	12-83-12	LOW.SPD-A	11231.0	.855	16.326	.738	12.1	2.74	.57	3.30
841349	14-83-12	LOW.SPD-A	11237.0	.570	11.088	.649	12.3	1.56	.53	2.10
841351	19-83-12	MED.SPD-B	11373.0	.758	18.965	.626	13.6	3.01	.55	3.56